INTRODUCTION

Falls are prevalent in older adults, with one out of three adults age 65 and over falling each year [1]. Of those who fall, 20-30% will suffer moderate to severe injuries, leading to a decrease in quality of life, loss of mobility and an increased risk of death [2]. These issues are especially apparent in nursing homes, with nearly 40% of admissions stemming from falls and as many as 75% of residents falling annually [3,4]. Hip protectors have been proposed as a proven means of preventing fall-related injuries. However, a study that analyzed 24 hour compliance at residential care homes showed that of the 51% of residents who agreed to wear hip protectors, compliance at night was as low as 3% [5]. Since many individuals prefer not to wear hip protectors and yet falls continue to be a problem, it has been proposed that modifying flooring to be more compliant may be an alternative to reduce the risk of injuries from falls. Two commercially-made compliant floors have been identified as a passive intervention approach that may protect against multiple types of fall-related injuries by reducing femoral impact by up to 50% [6]. It has been proposed that the increased compliance in these floors minimally impacts balance, however, work in this area has been limited to date. The objective of this study was to analyze the effect of compliant flooring (SofTile and SmartCell) on quiet-standing and limits of stability in an older adult population.

METHODS

Ten healthy older adults participated in this study (4 female, 6 male; mean age 72.6 ± 7.6 years; mean height 169.9 ± 9.8 cm; mean weight 80.3 ± 15.9 kg). All subjects were free of diseases, disorders, or injuries that may have affected their ability to walk or stand without assistance. Subjects gave written informed consent and the University of Dayton IRB approved all procedures.

Each subject performed static balance tests while barefoot on a force plate (Bertec Corporation, Model BP 5050). The main factor of interest was the flooring condition: flat plate, SofTile, and SmartCell. Two trials of each the eyes open (EO) and eyes closed (EC) conditions, and the Limits of Stability (LOS) test, were collected on each floor in a random order, totaling 18 trials per subject. For the EO and EC conditions subjects were told to stand comfortably with their feet about hip width apart, looking straight ahead, arms at their side, without talking, and while remaining as still as they could. Anterior-posterior (A/P) and medial-lateral (M/L) center of pressure (COP) data was collected for thirty seconds at 1000 Hz for each trial. For the LOS condition the subjects were instructed to lean forward, backward, to the left, and to the right using an ankle strategy. Subjects stepped off of the plate after each floor sample and were given a 3-minute break. From the COP data the A/P Sway Range, M/L Sway Range and Mean Sway Velocity were calculated. A multivariate analysis of variance (MANOVA) was performed to determine the statistical significance (p<0.05) of the flooring conditions, as well as vision. A post hoc analysis to compare between floorings was also performed.

RESULTS AND DISCUSSION

Figure 1 shows the mean A/P and M/L sway ranges for quiet-standing on each of the flooring samples. Statistical analysis revealed that the factor ‘flooring’ significantly affected A/P Sway Range measures (p=0.029). No statistical differences existed for the other postural sway parameters. Though vision did, as expected, significantly affect postural sway, an interaction between vision and flooring was not found (p>0.05 for all). Table 1 provides the p-values for the statistical analysis.
A post-hoc analysis revealed that for the A/P Sway Range results statistical differences were seen for the Flat Plate-SofTile (p=0.044) and Flat Plate-SmartCell (p=0.012) comparisons, but there was no statistical significance for the SmartCell-SofTile (p=0.582) comparison. A/P Sway Range was higher on the compliant surfaces, indicating increased instability/poorer performance.

These results suggest that compliant flooring may have an effect on the postural stability of an individual while standing. These findings are similar to those of Wright et al. who found small but significant differences in postural stability during quiet-standing across flooring samples in older women [6]. Increased sway can be an indicator of decreased postural instability and has previously been linked to increased likelihood of falling. More research now needs to be done to determine the implications of the significant, yet rather small (approximately 5 mm), differences observed in A/P Sway Range results.

This study also included the Limits of Stability task to examine how the flooring might impact movements requiring weight shifting. To date it appears that this is the first study to analyze LOS on compliant flooring. No statistically significant differences were found in sway ranges during the Limits of Stability task. With an observed power of 0.184 for A/P sway range and 0.124 for M/L sway range, more participants are needed to confirm this conclusion. Trends suggest individuals may achieve more range of motion (larger LOS) in the A/P direction on the flat plate, while the M/L sway range does not appear affected. It is possible that with a larger sample, these trends may become significant.

Future work is now underway to examine the effects of the compliant flooring on postural stability in older adults at higher risk of falling due to neurological impairment. This work will also examine how the flooring affects more functional movements such as while turning or retrieving an object from the floor.

**CONCLUSIONS**

It was found that compliant flooring may influence postural stability during quiet standing in the A/P direction. The clinical and practical significance of these findings as it relates to the dynamic balance and fall risk is yet to be determined.

**REFERENCES**

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